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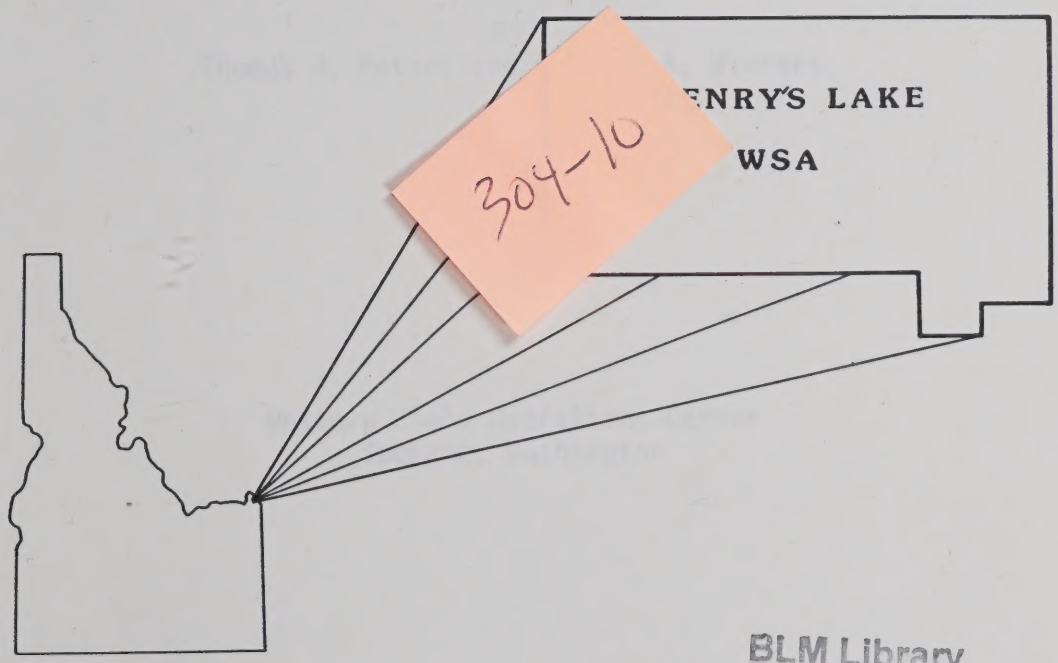

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MINERAL RESOURCES OF THE HENRY'S LAKE WILDERNESS STUDY AREA, FREMONT COUNTY, IDAHO

By
Thomas J. Peters and Richard A. Winters

Western Field Operations Center
Spokane, Washington

UNITED STATES DEPARTMENT OF THE INTERIOR
Donald P. Hodel, Secretary

BUREAU OF MINES
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PREFACE

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and U.S. Bureau of Mines to conduct mineral surveys on U.S. Bureau of Land Management administered land designated as Wilderness Study Areas ". . .to determine the mineral values, if any, that may be present . . . ." Results must be made available to the public and submitted to the President and the Congress. This report presents the results of a Bureau of Mines mineral survey of the Henry's Lake Wilderness Study Area (ID-035-077), Fremont County, ID.

This open-file report will be summarized in a joint report published by the U.S. Geological Survey. The data were gathered and interpreted by Bureau of Mines personnel from Western Field Operations Center, East 360 Third Avenue, Spokane, WA 99202. The report has been edited by members of the Branch of Resource Evaluation at the field center and reviewed at the Division of Mineral Land Assessment, Washington, DC.

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

ft	foot
g	gram(s)
mi	mile
ppb	part per billion
ppm	part per million
%	percent

SUMMARY

In 1987, at the request of the U.S. Bureau of Land Management, the Bureau of Mines studied the 350-acre Henry's Lake Wilderness Study Area (ID-035-077) in order to evaluate its identified mineral resources. The Wilderness Study Area is located in northern Fremont County, ID, approximately 140 air miles north-northeast of Pocatello and 3 miles south of the Montana border.

The Wilderness Study Area is near the north shore of Henry's Lake at the foot of the southwest-facing slope of Black Mountain. Archean hornblende gneiss, the main rock type present, crops out northeast of the Madison Range Fault, which trends northwest across the southwest corner of the Wilderness Study Area.

Two mineral properties occur in the Wilderness Study Area and vicinity. Examination of Bureau of Land Management mining claim data during library research disclosed the dolostone-associated Tick Heaven talc claim group adjacent to the Wilderness Study Area near the eastern boundary. Field traverses discovered three prospect pits in iron-rich gneiss near two small outliers of Cambrian strata within down-dropped fault blocks near the northeast corner of the Wilderness Study Area.

No talc, iron, or other mineral resources were identified within or near the Henry's Lake Wilderness Study Area.

INTRODUCTION

This report describes the USBM (U.S. Bureau of Mines) portion of a cooperative study with the USGS (U.S. Geological Survey) to evaluate mineral resources and resource potential of the Henry's Lake WSA (Wilderness Study Area) (ID-035-077) at the request of the BLM (U.S. Bureau of Land Management). The USBM examines individual mines, prospects, claims, and mineralized zones, and evaluates identified mineral and energy resources. The USGS evaluates potential for undiscovered resources based on areal geological, geochemical, and geophysical surveys. Results of the investigations will be used to help determine the suitability of the WSA for inclusion into the National Wilderness Preservation System. Although the immediate goal of this and other USBM mineral surveys is to provide data for the President, Congress, government agencies, and the public for land-use decisions, the long-term objective is to ensure the Nation has an adequate and dependable supply of minerals at a reasonable cost.

Setting

Henry's Lake WSA is located near the northern boundary of eastern Idaho (fig. 1). It consists of 350 acres (mainly the N. 1/2 sec. 33, T. 16 N., R. 43 E.) along the foot of Black Mountain at the south end of the Madison Range near the north shore of Henry's Lake (fig. 2). Elevations range from 6,550 ft, at the southwest corner of the WSA, to 7,680 ft at the northwest corner. The WSA is part of a southwest-facing mountain slope receiving direct sunlight, which forms a semiarid mesoclimate. Most precipitation comes as winter snow. Vegetation includes grass, sage brush, ponderosa pine, aspen and Douglas fir.

Previous Studies

Regional and areal geology relevant to the Henry's Lake WSA has been described by Mitchell and Bennett (1979), James and Hedge (1980), Pardee (1950), and Witkind (1972), and has been summarized within a phase I-type resource evaluation of the WSA and vicinity by Fredricksen and Fernette (1983).

Present Study

The present study included prefield, field, and report preparation phases. Prefield preparation included a library search of pertinent geological and mining literature and examination of BLM master title plats and current mining claim recordation data to search out actively held mineral properties and property owners.

Field work was conducted during June 1987. A talc claim group east of the WSA (fig. 2 and table 1), reported in BLM records, was examined and sampled. Three prospect pits in the northeast part of the WSA and vicinity, found while traversing the study area, were also examined and sampled. Sampling methods are detailed in appendix A. Technical terms used in this report are needed to evaluate possible mineral resources or the reserve base at prospects and mineralized areas; definition of terms can be found in the Glossary of Geology (Bates and Jackson, 1980).

ACKNOWLEDGEMENTS

The authors thank Richard "Rick" L. Weeks, geologist, Cyprus Industrial Minerals Company, Englewood, CO, and John Childs, consulting geologist, Bozeman, MT, for helpful information on the Tick Heaven talc claims and talc deposits of the region. Mr. and Mrs. E. L. "Dutch" Machamer and Stanley Goode, graciously provided access to the study area across their properties. James A. Canwell, WFOC, assisted with laboratory studies.

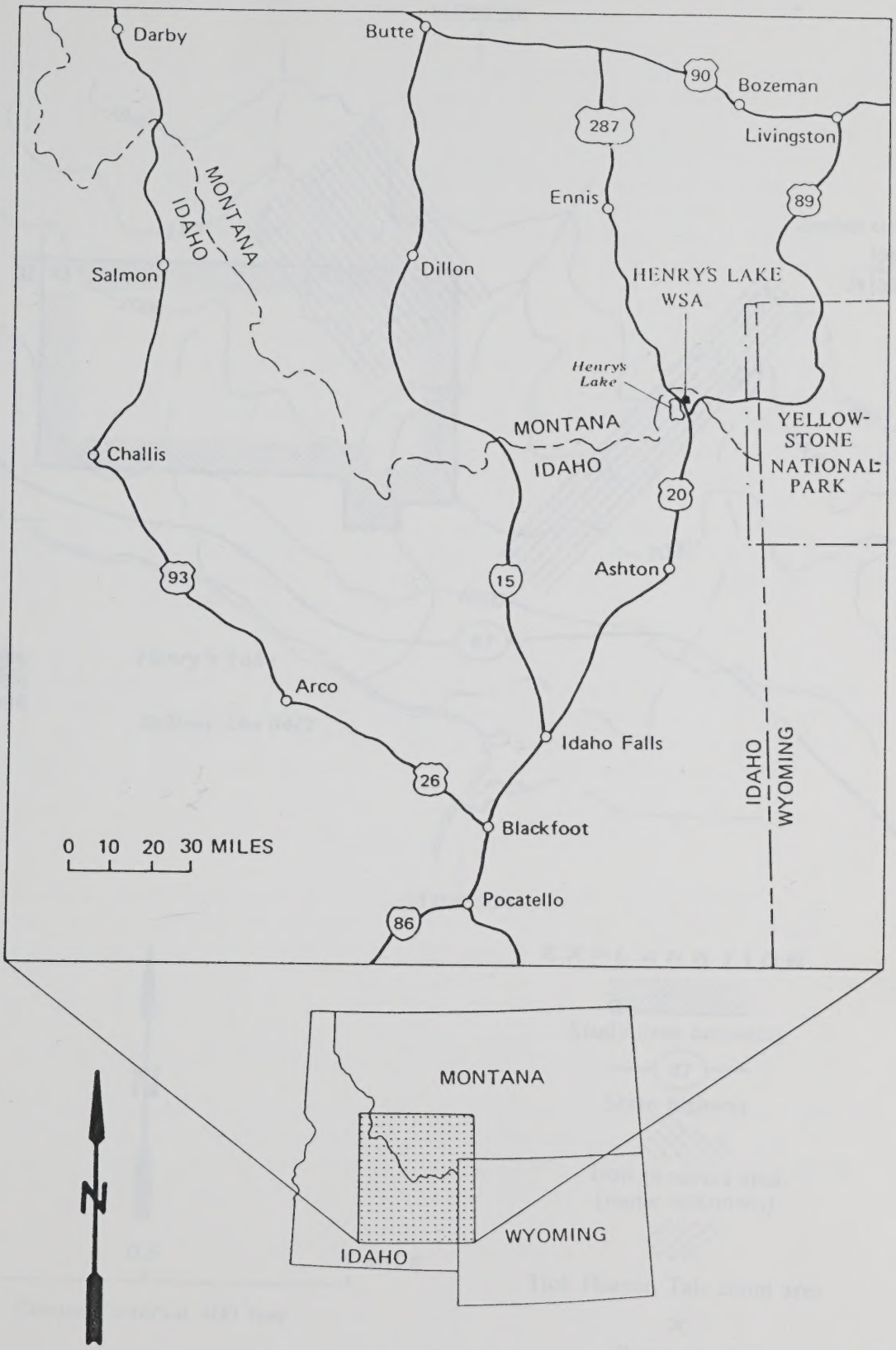

FIGURE 1.– Location of the Henry's Lake Wilderness Study Area (ID-035-077), Fremont County, ID

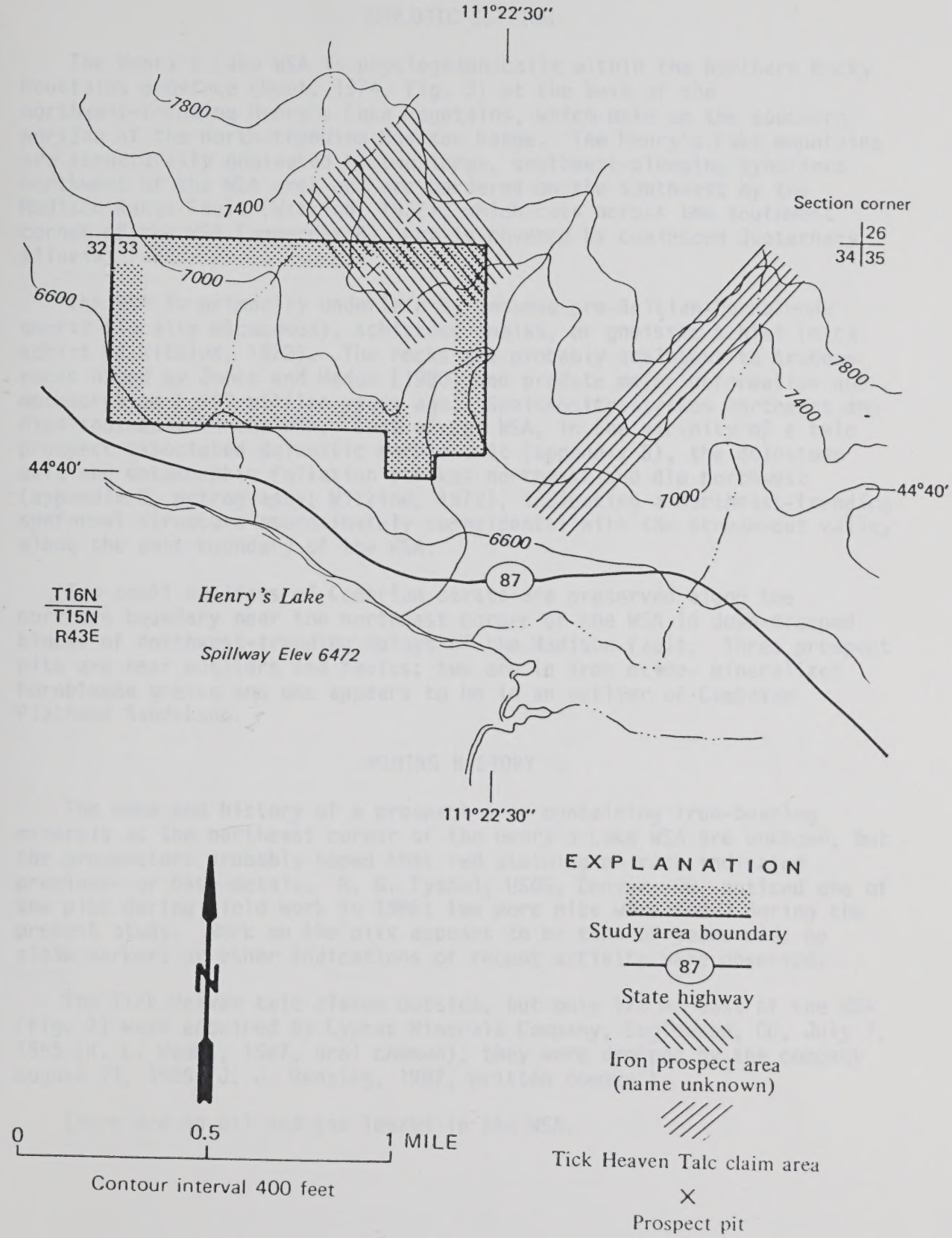

FIGURE 2.– Claim and prospect areas in the Henry's Lake Wilderness Study Area (ID-035-077) and vicinity, Fremont County, ID

GEOLOGIC SETTING

The Henry's Lake WSA is physiographically within the Northern Rocky Mountains province (Hunt, 1974, fig. 3) at the base of the northwest-trending Henry's Lake Mountains, which make up the southern portion of the north-trending Madison Range. The Henry's Lake mountains are structurally dominated by two large, southwest-plunging synclines northwest of the WSA area and are bordered on the southwest by the Madison Range Fault (Witkind, 1972), which cuts across the southwest corner of the WSA (appendix B), but is covered by coalesced Quaternary alluvial fans.

The WSA is primarily underlain by unnamed pre-Beltian hornblende quartz (locally micaceous), schistose gneiss, or gneissic schist (mica schist of Witkind, 1972). The rocks are probably analogous to Archean rocks dated by James and Hedge (1980) and predate major deformation and metamorphism 2,750 million years ago. Gneissosity strikes northeast and dips southeast in the WSA. East of the WSA, in the vicinity of a talc prospect associated dolomitic marble unit (appendix B), the dolostone unit and metamorphic foliation strikes northeast and dip northwest (appendix C, petrography; Witkind, 1972), indicating a northeast-trending synformal structure approximately coincidental with the stream-cut valley along the east boundary of the WSA.

Two small outliers of Cambrian strata are preserved along the northern boundary near the northeast corner of the WSA in down-dropped blocks of northwest-trending splays of the Madison fault. Three prospect pits are near outliers and faults; two are in iron oxide- mineralized hornblende gneiss and one appears to be in an outlier of Cambrian Flathead Sandstone.

MINING HISTORY

The name and history of a prospect area containing iron-bearing minerals at the northeast corner of the Henry's Lake WSA are unknown, but the prospectors probably hoped that red staining on rock indicated precious- or base-metals. R. G. Tysdal, USGS, Denver, CO, noticed one of the pits during field work in 1986; two more pits were found during the present study. Work on the pits appears to be tens of years old; no claim markers or other indications of recent activity were observed.

The Tick Heaven talc claims outside, but only 1/4 mi east of the WSA (fig. 2) were acquired by Cyprus Minerals Company, Englewood, CO, July 7, 1985 (R. L. Weeks, 1987, oral commun); they were dropped by the company August 11, 1986 (J. J. Bensing, 1987, written commun.).

There are no oil and gas leases in the WSA.

CLAIM AND PROSPECT AREAS

Iron Prospect Area

Iron oxide minerals (primarily hematite) (fig. 2 and table 1) occur as veinlets within, and as coatings on, amphibole quartz schistose gneiss. Gneissosity strikes northeast, dips southeast (appendix C, nos. 3, 7). Mineralization, characterized by concentration of iron and depletion of many other elements (appendices D and E), occurs beneath the Precambrian-Cambrian unconformity and appears to be lateritic.

Workings consist of three pits (fig. 2): the north pit is in iron oxide-mineralized gneiss, extends 10 ft northwest, 7 ft northeast, and is 4 ft deep (appendices B and C, sample no. 3); the south pit, in similar gneiss, was driven 12 ft N. 60° W. into a southeast-facing slope near the hillcrest, is 7 ft wide, and is open to the southwest (sample nos. 5-7); the west pit, which appears to be underlain by Flathead Sandstone because of abundant boulder float, extends 30 ft N. 30° E., and is 10 ft wide and 5 ft deep (sample no. 4).

Iron resources do not occur, and no other metals are known to be concentrated, in the WSA. Four samples from the prospect averaged 17.08 percent iron (appendix E); the average iron content of minable ore is 64 percent (U.S. Bureau of Mines, 1988, p. 78), much higher than concentrations in the WSA.

Tick Heaven Claim Group

The Tick Heaven group of eight talc claims (fig. 2 and table 1) does not extend into the WSA, but does extend northeast across the north one-half of section 34 (T. 16 N., R. 43 E.), which is contiguous with the east boundary of the WSA. The claim area (fig. 2) is two claims wide (1,200 ft) and four claims long (6,000 ft) and covers the northeast-trending Precambrian dolomitic marble unit (appendix B). Talc occurs as the main constituent in scattered pieces of talc-schist float (loose rock) along the northwest contact of the dolomitic marble between elevations of 7,000 and 7,200 ft, near an inferred northwest-trending fault (appendices B and F).

Talc is an industrial mineral used in ceramics, paints, paper, and cosmetics (U.S. Bureau of Mines, 1988, p. 158). There are no workings at the prospect. Talc shist was not seen in outcrop and no mineral resources were identified.

Placer

Two alluvial grab samples (appendix B, sample nos. 12 and 13) contained no free gold 1/.

1/ Sample no. 12 contained 0.20 gram magnetic, and 58.26 g nonmagnetic heavy mineral concentrate; sample no. 13 contained 0.37 magnetic, and 60.88 g nonmagnetic concentrate.

APPRAISAL OF MINERAL RESOURCES

No mineral resources have been identified in the Henry's Lake WSA. A low-grade iron occurrence along the northeast boundary has no economic significance. Sufficient tonnage does not occur; the occurrence is also much lower in grade than other deposits in the region (Bayley and James, 1973, p. 954), and is far from low cost water transportation which accounts for virtually all ore transport to domestic furnaces (U.S. Bureau of Mines, 1985, p. 392, 395). Resources of other commodities are not indicated at the iron occurrence, because base- and ferro alloy-metals are depleted, and precious-metal concentrations are not present.

Talc occurs 1/4 mi east of the WSA on the Tick Heaven claim group. The talc was seen only as float, and no resource was identified. The occurrence is associated with a dolomitic marble; however, dolostone and talc cannot be completely ruled out in unexposed rock beneath the WSA.

Placer samples from two WSA drainages do not indicate a resource of free gold or other valuable heavy minerals.

TABLE 1.--Claim and prospect areas in the Henry's Lake Wilderness Study Area and vicinity, Fremont County, ID

[Asterisk (*) indicates prospect is outside, but within 1 mi of the WSA]

Map no.	Name	Summary	Workings and production	Sample and resource data
1	Iron prospect area (name unknown)	Iron oxide minerals (primarily hematite) occur as veinlets within, and as coatings on, Precambrian amphibole quartz gneiss. Mineralization is directly beneath the Precambrian-Cambrian unconformity and appears to be lateritic. Iron is the only concentrated element; many other elements are depleted.	Three small pits; no production recorded or indicated by minor workings.	Four samples of mineralized amphibole quartz gneiss average 17% iron compared to an average iron content of 64% for currently minable ore. No resources were identified because of the low iron content and small size.
*2	Tick Heaven claim group	A group of eight talc claims, formerly held by Cyprus Minerals Company, is 1/4 mi east of the WSA. Talc [$Mg_3 Si_4 O_{10} (OH)_2$] occurs as the major constituent in scattered pieces of bluish gray schist float along the northwest contact of dolomitic marble between elevations of 7,000 and 7,200 ft.	None.	One select grab sample contained approximately 75% talc. Talc was not seen in outcrop, therefore, no resources were identified.

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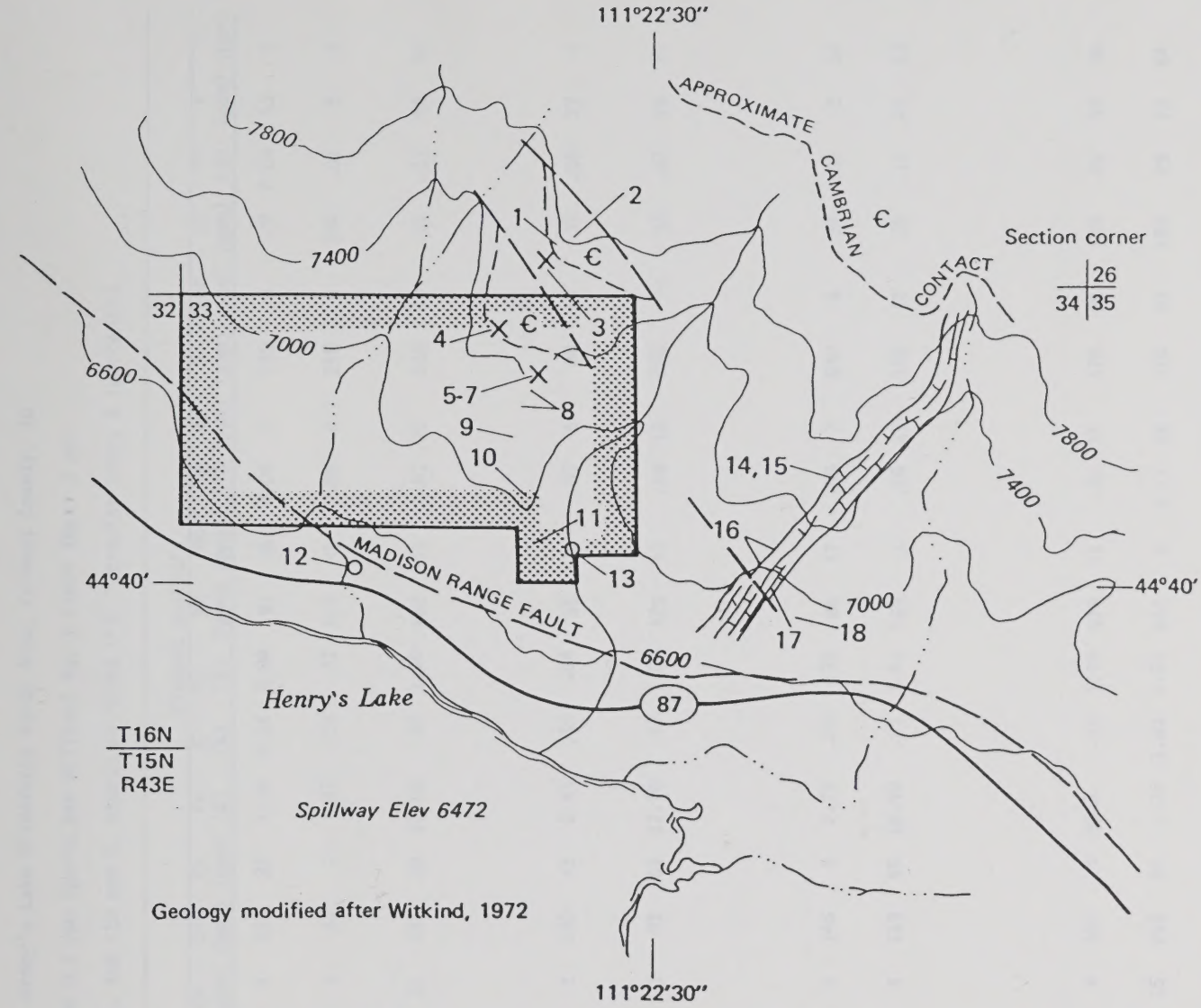
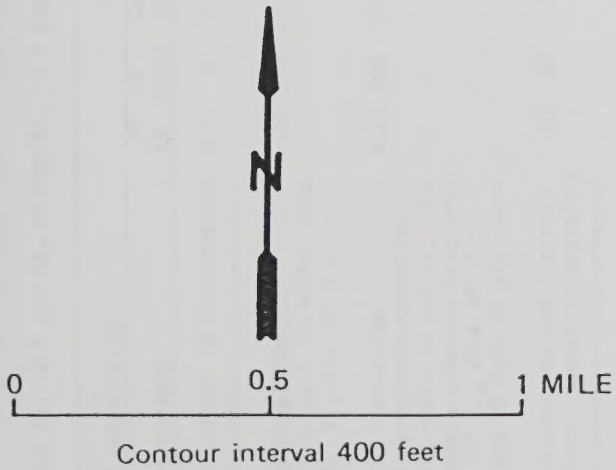
APPENDIX A.--Sampling and analytical procedures

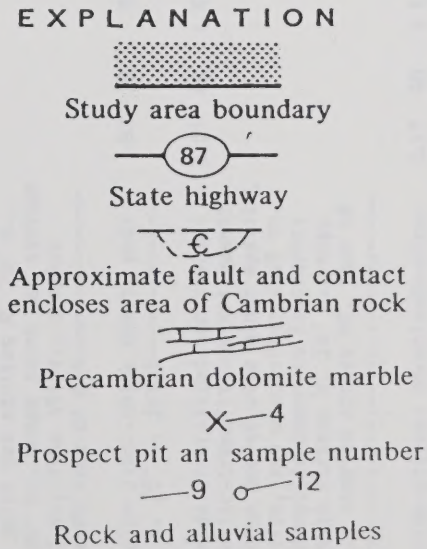
A total of 18 samples, 16 rock and 2 alluvial, were taken (appendix B). Rock samples included 3 chip--a line of continuous rock chips taken across laminar structures, such as metamorphic foliation, or across working faces in order to get a representative sample; 7 random chip--taken at random intervals from homogeneous outcrops; 1 select chip--atypical or mineralized rock from outcrop; 1 select grab--atypical or mineralized float (loose rock) from soil cover; and 4 grab--float which is typical of bedrock in the vicinity (may, or may not, appear to be mineralized). Alluvial samples were grab-type, and were partially concentrated in the field. A 14-in.-diameter gold pan used in this study holds 1/250 yd^3 when filled level; each sample consisted of three level pans or 0.012 yd^3.

All samples were checked for radioactivity and fluorescence. Rock samples were prepared for analysis at WFOC (Western Field Operations Center) and were analyzed for 25 elements, including the major elements (except silicon and oxygen), at a commercial laboratory (appendix C). Analyses were by ICP (inductively coupled plasma) methods, except for gold, which was by NAA (neutron activation analysis). One rock sample was analyzed by x-ray diffraction for mineral identification at a commercial laboratory (appendix C, no. 16). Alluvial samples were further concentrated on a laboratory-size Wilfley 2/ table at WFOC and examined for free gold and other heavy minerals.

2/ Brand name is used for descriptive purposes only and is not intended as an endorsement by the U.S. Bureau of Mines.







APPENDIX B.—Sample locality and prospect geology map, Henry's Lake Wilderness Study Area, Fremont County, ID

APPENDIX C.--Analysis of rock samples from the Henry's Lake Wilderness Study Area, Fremont County, ID

[Analyses by ICP (gold by NAA); samples contain 0.5 ppm (parts per million) Ag, < (less than) 1 ppb (part per billion) Au, <0.5 ppm Be, <2 ppm Bi, <0.5 ppm Cd, and <10 ppm W, except as noted (*); > greater than; % (percent)]

Sample description			Element analysis																		
No.	Type	Petrography	Al (%)	Ba (ppm)	Ca (%)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	K (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Ni (ppm)	P (ppm)	Pb (ppm)	Sr (ppm)	Ti (%)	V (ppm)	Zn (ppm)
1	Grab	Brownish-red medium- to fine-grained Flathead sandstone----------	0.61	30	0.36	1	321	22	1.06	0.17	0.04	91	26	0.04	7	140	8	21	0.04	13	8
2*	Random chip--	Brownish-gray algal Meagher limestone; 0.5- to 4 in.-thick beds strike N. 25° W., dip 35° E.-------	.69	30	>25.0	1	13	2	.37	.35	.31	217	<1	.04	4	250	6	254	.02	5	6
3*	8-ft chip	Manganese- and iron-oxide mineralized hornblende-tremolite-garnet-quartz gneissic schist; <0.5 to 5 mm hematite-cemented fractures; strikes N. 35° E., dips 48° E.; sampled across NE face of pit------	3.30	260	1.58	12	187	28	13.20	.59	1.00	583	<1	.61	27	510	18	91	.13	50	48
4	Grab	Reddish-brown cross bedded Flathead Sandstone; local hematitic argillite clasts----------	.83	20	.04	1	332	<1	2.43	.35	.04	31	20	.03	5	80	14	35	.08	22	4
5*	4.5-ft chip	Iron oxide mineralized amphibole-quartz schistose gneiss; <0.5 to 5 mm hematite-cemented fractures; major joint set strikes N. 75° W., dips 40° S., minor joint set strikes N. 55° W., dips 45° W.; sampled across NW face of pit----------	2.06	50	1.91	3	91	61	17.70	.12	1.04	429	<1	.18	12	550	4	47	.07	28	41
6	Select chip	Lenticular 3-in.-thick quartz pods along N. 75° W. joint----------	.83	10	.97	1	146	2	2.71	.04	.35	84	17	.09	7	840	8	34	.02	12	10
7	6.1-ft chip	Iron oxide mineralized hornblende-actinolite-tremolite-garnet-quartz schistose gneiss with minor apatite, magnetite, and muscovite; <0.5 to 5 mm hematite-cemented fractures; foliation strikes N. 30° E., dips 57° E.; sampled across NE. face of pit----------	2.67	60	1.54	4	129	49	16.90	.21	1.41	529	1	.10	19	550	<2	39	.11	41	43
8*	Grab	Iron oxide-stained hornblende-mica-quartz gneiss----------	3.17	40	3.13	4	100	4	20.5	.19	1.45	574	<1	.31	15	470	10	100	.09	35	36
9*	Random chip	Fine-grained quartz-biotite-phlogopite gneissic schist; foliation strikes N. 30° E., dips 40° E.----------	6.14	620	1.19	15	242	24	3.36	1.83	1.37	451	6	1.77	42	370	40	128	.29	72	64

APPENDIX C.--Analysis of rock samples from the Henry's Lake Wilderness Study Area, Fremont County, ID--Continued

Sample description			Element analysis																		
No.	Type	Petrography	Al (%)	Ba (ppm)	Ca (%)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	K (%)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Ni (ppm)	P (ppm)	Pb (ppm)	Sr (ppm)	Ti (%)	V (ppm)	Zn (ppm)
10	Random chip	Fine-grained dark steel-gray hornblende-quartz schistose gneiss; contorted foliation--------	7.00	230	4.74	47	156	55	8.86	0.34	3.10	1340	<1	2.39	85	980	12	148	1.06	261	103
11*	do----	Very finely laminated hornblende schistose gneiss----------	7.31	230	6.60	46	284	56	8.24	.46	4.11	1285	<1	1.78	109	700	6	198	.86	242	90
14*	do----	Dark-gray fine-grained hornblende gneiss; adjacent to metadolostone; apparent bedding, contact, and foliation strikes N. 35° E., dips 65° W.----------	6.23	210	5.39	41	87	89	9.39	.59	3.04	1535	<1	1.95	48	590	10	118	.90	305	112
15*	do----	Coarse-grained dolomitic marble-----	.74	20	19.35	<1	19	3	.43	.22	9.52	3700	<1	.05	6	10	<2	53	.02	8	11
16	Select grab	Dark-bluish-gray talc schist; flat pebble and cobble float averages 0.3-in.-thick----------	.49	40	3.18	<1	12	<1	1.23	.02	15.60	692	<1	.04	5	<10	<2	7	.01	6	18
17*	Random chip	White dolomitic marble; apparent bedding, contact and foliation strikes N. 40° E., dips 50° W.-----	.30	10	18.85	<1	19	<1	.52	.04	10.90	4280	<1	.05	1	<10	<2	28	<.01	2	5
18*	Grab	Dark-gray quartz mica scist; minor hornblende, vesuvianite, and plagioclase; weathers brown--------	7.53	440	.86	24	276	77	4.37	4.48	1.59	1385	4	.28	72	130	26	62	.51	144	104

* Sample no. 2 - 2 ppm Bi; no. 3 - 6 ppb Au; no. 5 - 1.0 ppm Be; no. 8 - 10 ppm W; no. 9 - 1.5 ppm Be; no. 11 - 0.5 ppm Cd; no. 14 - 1.0 ppm Ag, 0.5 ppm Be; no. 15 - 0.5 ppm Cd; no. 17 - 0.5 ppm Cd; no. 18 - 1.0 ppm Be.

APPENDIX D.--Iron prospect (name unknown) geology

Eight samples were taken from the iron prospect area (appendices B and C). Analysis of the Meagher Limestone (sample no. 2) and the Flathead sandstone (sample nos. 1, 4) do not have elevated metal content indicative of mineralization, when compared to expected crustal abundances (Parker, 1967, p. D13-14); somewhat elevated iron, chromium, and molybdenum content of the sandstone may be typical for the Flathead, a transgressive unit over Precambrian rocks, which are typically iron oxide-stained. Hematitic alteration appears to predate Cambrian deposition and northwest-trending faults.

Iron oxide veinlets and stains were only noted in association with amphibole-quartz gneiss, but sampled material may include minor quartz-mica schist. The average element concentrations in four gneiss samples from the prospect area (appendices B and C, sample nos. 3, 5, 7, and 8) are compared to five gneiss and schist background samples from elsewhere in the WSA and vicinity in appendix D. A marked increase in iron and a corresponding depletion in all other elements, except phosphorous, can be seen in the iron-mineralized samples. Base-, ferro alloy-, and precious-metals are depleted in the prospect area. Iron appears to be the only concentrated element.

Iron mineralization may represent: 1) deformed and metamorphosed low-grade iron formation, or 2) the root zone of Precambrian lateritic weathering. Although an iron formation origin for the gneiss would account for low major element (especially aluminum) and many low minor element concentrations (James, 1981, tables 1 and 2), the iron content of the hematitic gneiss is only one-half of the iron content, and does not have the characteristic banded appearance of Archean iron formations common in the region (Bayley and James, 1973, p. 952-955). Petrography of the gneiss (appendix C), however, indicates the protolith may have been an iron-rich limy mud and sandy sediment which graded laterally into iron formation (James, 1966, p. W15).

Increase in iron by lateritic weathering is suggested by the position of the mineralization beneath the Precambrian-Cambrian unconformity, the lack of continuity of mineralization along the strike and down the dip of foliation (which is coincidental with bedding along the talc associated dolostone east of the WSA), the similarity in the fabric of stained and unstained hornblende gneiss, and increase in iron and decrease in other major and minor elements (appendix E). The hematite-mineralized gneiss would have constituted the weathered rock mantle beneath a lateritic soil profile, which has been removed by erosion. Three unaltered samples of gneiss (appendices B and C, nos. 10, 11, 14) are chemically similar amphibolite gneisses (Mason, 1978, p. 113) and are chemically similar to basalt, and two quartz biotite schist samples (nos. 9, 18) resemble intermediate volcanic rocks or argillites (Parker, 1967, p. D13). These are suitable source rocks for lateritic development of the element suite observed in the hematitic samples (see Lateritic Weathering, Lepp and Goldrich, 1964, p. 1049-1050), especially if relative concentration of Fe_2O_3 is greater than Al_2O_3 or TiO_2 in the deepest portions of the weathering zone (see Hotz, 1964, p. 371-381).

APPENDIX E.--Comparison of average element concentrations in iron oxide-mineralized gneiss and unmineralized gneiss and schist

[Undetected element concentrations were averaged using one-half of the detection limit]

Element	Unit of measure	Average of iron oxide-mineralized amphibolite gneiss samples (nos. 3, 5, 7, 8)	Average of unmineralized amphibolite gneiss and biotite schist (nos. 9-11, 14, 18)
Al (aluminum)	%	2.80	6.84
Ba (barium)	ppm	103.00	346.00
Ca (calcium)	%	2.04	3.76
Co (cobalt)	ppm	5.75	34.60
Cr (chromium)	ppm	126.75	209.00
Cu (copper)	ppm	35.50	60.20
Fe (iron)	%	17.08	6.84
K (potassium)	%	.28	1.54
Mg (magnesium)	%	1.23	2.64
Mn (manganese)	ppm	528.75	1199.20
Mo (molybdenum)	ppm	.63	2.30
Na (sodium)	%	.30	1.63
Ni (nickel)	ppm	18.25	71.2
P (phosphorus)	ppm	520.	554.
Pb (lead)	ppm	8.25	18.80
Sr (strontium)	ppm	69.25	130.80
Ti (titanium)	%	.10	.724
V (vanadium)	ppm	38.5	204.8
Zn (zinc)	ppm	42.0	94.6

APPENDIX F.--Tick Heaven talc claim group geology

The Tick Heaven Claim Group covered the dolostone east of the study area (appendix B). Five rock samples were taken (appendices B and C, nos. 14-18). The dolostone beds and metamorphic foliation strike N. 35° to 40° E. and dip 50° to 65° NW. A magnesium content of approximately 10 percent (appendix C, nos. 15, 17), suggests dolomite is the main carbonate mineral in the dolostone, and indicates similarity to a Type III marble (Berg, 1987) which hosts most talc deposits in the Ruby Range, and elswhere, in southwestern Montana.

Dark bluish-gray talc [$Mg_3Si_4O_{10}(OH)_2$]-bearing schist was seen only as pebble and cobble float along the northwest contact of the dolostone and was common only between elevations of 7,000 and 7,200 ft. A select grab sample (appendices B and C, no. 16) analyzed by x-ray diffraction contained predominantly talc ($\geq$75 percent), lesser calcite ($\geq$20 percent), and minor dolomite and tremolite. No quartz was detected. The select sample contained 15.60 percent magnesium, 3.18 percent calcium, 1.23 percent iron (appendix C, no. 16). Since most calcium occurs mainly as calcite rather than dolomite, most magnesium occurs as talc; only minor magnesium occurs in dolomite and tremolite ($\leq$1.0 percent), confirming the high talc grade. Other tests bearing on quality and grade such as grain size and shape, brightness and amphibole fiber content were not run. Samples of mica schist and dolostone proximal to the schist-marble contact (appendix C, nos. 14, 15) as well as talc schist (appendix C, no. 16) were analyzed to detect any contact-related metal concentrations, but none were found.

The talc occurrence resembles numerous occurrences and deposits in southwestern Montana described by Berg, 1979. All of these deposits occur in pre-Beltian sequence dolomitic marble; since none occur in suitable abundant Paleozic dolostone in the region, a Precambrian age is inferred (Berg, 1979, p. 14). Talc formation is generally considered a retrograde metamorphic event, because of destruction of talc during granulite and amphibolite-grade metamorphism. Talc at the Tick Heaven prospect may have formed during a 2,130 million year old metamorphic event reported by Giletti (1966).

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